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PALLID STURGEON
(Scaphirhynchus albus)

Draft Recovery Plan
June, 1992

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Prepared by the Pallid Sturgeon Recovery Team

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RECOVERY BACKGROUND AND STRATEGY

The pallid sturgeon (Scaphirhynchus albus) (Forbes and Richardson) was listed as an endangered species on September 9, 1990, (55 FR 36641) pursuant to the Endangered Species Act (Act) of 1973 (16 U.S.C. 1531 et. seq.) as amended. The range of the pallid sturgeon overlays three U.S. Fish and Wildlife Service (Service) Regions; Region 3, Region 4 and Region 6, with Region 6 having been designated the lead region for recovery. (Research functions are provided to all Service regions by Region 8.) Because of the wide range of the pallid sturgeon, its believed extreme rarity, numerous threats to species survival, and paucity of information on species life history and habitats; an eight member, multi-disciplinary recovery team was established to develop this Pallid Sturgeon Recovery Plan (Plan). In development of the Plan, the recovery team utilized the expertise of other sturgeon researchers and managers, and published literature.

The Introduction section, Part I, of this Recovery Plan describes the distribution, status, life history, and habitat-association information that is known about the pallid sturgeon. Reasons for listing and threats to the species are also described.

The Recovery section, Part II, provides the short- and long-term recovery objectives, which when reached, will achieve recovery of the species. The strategies to achieve recovery objectives are presented in the Recovery Outline and are grouped under four primary work areas. They are: 1.) protect pallid sturgeon populations, individuals, and their habitat, 2.) develop and implement a pallid sturgeon artificial propagation program, 3.) conduct research necessary for long-term recovery of the pallid sturgeon, 4.) develop a nationwide program to coordinate and implement conservation and recovery of all sturgeon species. Recovery tasks, which can be independently funded and carried out, are described for each strategy. Recovery tasks are listed in logical, not priority order.

The Implementation Schedule, Part III, of the Recovery Plan is essentially a summary table which indicates task priorities, task descriptions, duration of tasks, the agency or entity with the responsibility or administrative authority to fund or carry out the task, and lastly, estimated costs. All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

This Pallid Sturgeon Recovery Plan will be reviewed every 3 years and is subject to modification as needed by new findings, changes in species status, and the completion of recovery tasks.

PALLID STURGEON RECOVERY TEAM

Team Members

Mark Dryer
Team Leader
U.S. Fish and Wildlife Service
Fish and Wildlife Enhancement
1500 E. Capitol Ave.
Bismarck, ND 58501

Mark Harberg
U.S. Army Corps of Engineers
Missouri River Division
P.O. Box 103, Downtown Station
Omaha, NE 68101-0103

Dr. Frank Chapman
University of Florida
Dept. of Fisheries and
Aquaculture
7922 NW 71st Street
Gainesville, FL 32606

Bobby Reed
Louisiana Dept. of Wildlife
and Fisheries
1213 N. Lakeshore Drive
Lake Charles, LA 70601

Pat Clancey
Montana, Dept. of Fish,
Wildlife and Parks
P.O. Box 265
Ft. Peck, MT 59223

James Riis
South Dakota Game, Fish and
Parks Department
523 E. Capitol
Pierre, SD 57101

Kim Graham
Fish and Wildlife Research
Center
Missouri Dept. of Conservation
1110 South College Avenue
Columbia, MO 65201

Al Sandvol
U.S. Fish and Wildlife Service
Fish and Wildlife Assistance
Office
1500 E. Capitol Avenue
Bismarck, ND 58501

Team Consultant

Dr. Kent Keenlyne
U.S. Fish and Wildlife Service
420 South Garfield
Pierre, SD 57501

DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not necessarily represent the views nor the official positions or approvals of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved.

EXECUTIVE SUMMARY

Current Species Status: The pallid sturgeon was listed as endangered on September 6, 1991 (55 FR 36641). Although the species range is large, catch records are extremely rare. The species may be close to extirpation in the wild.

Habitat Requirements and Limiting Factors: The range of the pallid sturgeon is primarily the Missouri River and the Mississippi River downstream of the confluence with the Missouri River. Pallid sturgeon require large, turbid, free-flowing, braided-channel riverine habitat with sandy or rocky substrate. Modifications to the pallid sturgeon's habitat have blocked movements, destroyed or altered its spawning areas, reduced its food sources or its ability to obtain food, altered water temperatures, and changed the hydrograph. Over-fishing, pollution, and hybridization may have also led to the species' dramatic decline.

Recovery Objective: Downlisting. The short-term recovery objective for the pallid sturgeon is to prevent extirpation of populations presently occurring in the wild within the next 5 years (1997). The long-term objective is to achieve naturally reproducing, self-sustaining populations within designated Missouri and Mississippi River reaches within the next 48 years (2040).

Actions Needed:

1. Protect pallid sturgeon populations, individuals, and their habitat.
2. Develop and implement a pallid sturgeon artificial propagation program.
3. Conduct research necessary for long-term recovery of the pallid sturgeon.
4. Develop a nationwide program to coordinate and implement conservation and recovery of all sturgeon species.

Recovery Cost : *at least $29.7 million

Work Areas	1.	2.	3.	4.
1993	261	1329	1724	79
1994	258	620	1580	99
1995	258	110	1205	79
1996-1997	536	760	2240	178
1998-2040	4410	1750	8400	3855
Total ($000's)	5723	4569	15149	4290

*Does not represent costs associated with some tasks in Work Area 1., which are undeterminable at this time.

Date of Recovery: Short-term objective - 1997; Long-term (Recovery) objective - 2040

Part I

INTRODUCTION

History:

The pallid sturgeon (Scaphirhynchus albus) evolved from an ancient group of bony fishes, the subclass Paleopteryii, which was dominant during the Paleozoic Era. This group continued to flourish through the late Paleozoic and early Mesozoic, but most species became extinct sometime in the Mesozoic. The living descendants of this group in North America include paddlefish (Polyodontidae), and eight species of sturgeon (Acipenseridae).

The North American species of sturgeon, in addition to the pallid sturgeon, are shovelnose sturgeon, Scaphirhynchus platorynchus (Rafinesque); white sturgeon, Acipenser transmontanus (Richardson); green sturgeon, Acipenser medirostris (Ayres); Atlantic sturgeon, Acipenser oxyrhynchus (Mitchill); shortnose sturgeon, Acipenser brevirostrum (Lesueur); and lake sturgeon, Acipenser fulvescens (Rafinesque). An eighth species, the Alabama sturgeon, Scaphirhynchus suttkus (Williams), was recently described from the Mobil Basin in Alabama and Mississippi (Williams and Clemmer 1991). This is outside the range of the pallid sturgeon and is not included in further discussions of Scaphirhynchus species in this plan.

The pallid sturgeon was first described by S.A. Forbes and R.E. Richardson in 1905 from nine specimens collected from the Mississippi River near Grafton, Illinois, in June 1904 (Forbes and Richardson 1905). Known locally as the white sturgeon, they named it Parascaphirhynchus albus and suggested it be considered as its own genus. Later classifications, however, placed it in the genus Scaphirhynchus where it has remained (Bailey and Cross 1954).

Electrophoretic analysis of the two species of Scaphirhynchus have suggested a very close genetic relationship. Phelps and Allendorf (1983), using electrophoretic techniques, were unable to distinguish the species by looking at 37 enzyme systems. The authors concluded that the close genetic similarity was due to recent or incomplete reproductive isolation.

General Description:

The pallid sturgeon has a flattened, shovel-shaped snout; long, slender, and completely armored caudal peduncle; and lacks a spiracle (Smith 1979). As with other sturgeon, the mouth is toothless, protrusible, and ventrally positioned under the snout. The skeletal structure is primarily cartilaginous (Gilbraith et al. 1988). Pallid sturgeon are similar in appearance to the more common, darker, shovelnose sturgeon. Pflieger (1975) reports the principle features distinguishing the pallid sturgeon from the shovelnose sturgeon are the paucity of dermal ossifications on the belly, 24 or more anal fin rays, 37 or more dorsal fin rays, and inner barbels under the snout that are much shorter than the outer barbels, with the inner barbels less than six times the length of the head.

Bailey and Cross (1954) found the ratio of the inner and outer barbels between pallid sturgeon and shovelnose sturgeon provides one of the quickest and most reliable means for separation of the Scaphirhynchus species: the inner barbel is contained in the outer 1.2-1.5 times in shovelnose sturgeon and 1.6-2.4 times in pallid sturgeon. Bailey and Cross (1954), also found that the inner barbels of pallid sturgeon typically lie ahead of the outer barbels, unlike on shovelnose sturgeon where they are typically in-line. Furthermore, in pallid sturgeon all the barbels are further back on the lower surface of the snout than in shovelnose sturgeon: the "snout tip to outer barbel/mouth to inner barbel" ratio varies from 2.3 to 3.3 in pallid sturgeon and 1.3 to 2.2 in shovelnose sturgeon (Bailey and Cross 1954) (Figure 1).

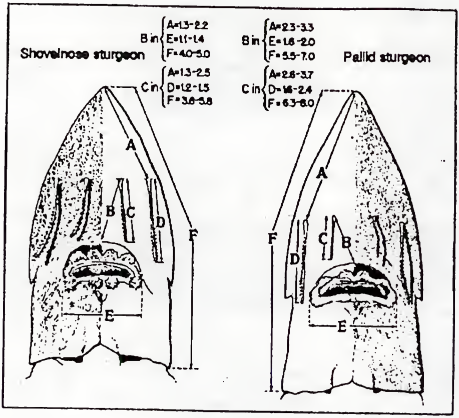
Shovelnose sturgeon
B in A=1.3-2.2 E=1.1-1.4 F=4.0-5.0
C in A=1.3-2.5 D=1.2-1.5 F=3.6-5.8
Pallid sturgeon
B in A=2.3-3.3 E=1.6-2.0 F=5.5-7.0
C in A=2.8-3.7 D=1.6-2.4 F=6.3-8.0
A
B
C
D
E
F
A
B
C
D
E
F

Figure 1: Comparative diagrams of the ventral surface of the head of shovelnose sturgeon and pallid sturgeon, showing several measurement ratios of value for identification. Redrawn from Bailey and Cross (1954).

The pallid sturgeon is one of the largest fish found in the Missouri/Mississippi River drainage, with specimens approaching 39 kilograms (kg) (85 lbs) reported (Gilbraith et al. 1988).

Adult pallid sturgeon collected from the upper Missouri River have been noticeably larger than adults collected from the middle Missouri River and

Mississippi River. Of pallid sturgeon collected from the Missouri River in Montana and North Dakota, the maximum weight recorded was approximately 39 kg (85 lbs). In South Dakota and Nebraska, the maximum weight recorded was approximately 21 kg (46 lbs); and of pallid sturgeon collected from the Mississippi River, the maximum weight recorded was approximately 12 kg (26 lbs).

Historical Distribution and Abundance:

The range of pallid sturgeon as described by Bailey and Cross (1954) encompasses the middle and lower Mississippi River, the Missouri River, and the lower reaches of the Platte, Kansas, and Yellowstone Rivers.

Keenlyne (1989) updated Bailey and Cross (1954). Keenlyne reported pre-1980 catch records in the Mississippi River from its mouth upstream to its confluence with the Missouri River (1,154 river miles), in the lower 35 miles of the Big Sunflower and St. Francis Rivers (tributaries to the Mississippi); in the Missouri River from its mouth to Fort Benton, Montana (2,065 river miles), in the lower 40 miles on the Kansas River, the lower 21 miles on the Platte River and the lower 200 miles of the Yellowstone River (tributaries to the Missouri). The total length of its range is approximately 3,550 miles of river (Figure 2). States within this range are Montana, North Dakota, South Dakota, Nebraska, Iowa, Kansas, Missouri, Illinois, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana.

The population status of pallid sturgeon is poorly known, but available information suggests a probable decline since the species was described. Literature references usually state that the species was always uncommon (Forbes and Richardson 1905; Bailey and Cross 1954). At the time of its original description, pallid sturgeon were reported to comprise 1 in 500 river sturgeons captured in the Mississippi River at Grafton, Illinois (Forbes and Richardson 1905). It was also reported that pallid sturgeon were more abundant in the lower Missouri River near West Alton, Missouri, where it comprised one-fifth of the river sturgeons captured (Forbes and Richardson 1905). Bailey and Cross (1954) provided additional information on the proportions of pallid sturgeon in the total commercial catch of river sturgeons from various parts of the species range as follows: Kansas River at Lawrence, Kansas (8 percent); Missouri River in South Dakota, 3 of 62 specimens (5 percent); and Mississippi River at New Orleans, 3 of 4 specimens (75 percent). Fisher (1962) recorded 4 of 13 river sturgeons (31 percent) from the Missouri River in Missouri as pallid sturgeon.

Present Distribution and Abundance:

The pallid sturgeon remains one of the rarest fish of the Missouri and Mississippi River Basins. Carlson and Pflieger (1981) stated that the pallid sturgeon was rare, but widely distributed in the Missouri River and the Mississippi River downstream from the mouth of the Missouri. More recent surveys have not provided information to change that estimate of distribution and abundance. Catch records reported by Keenlyne (1989) and records added to that data current to April 1992 reveal scattered reports of occurrence from throughout the species' historic range. Reports of most recent and frequent

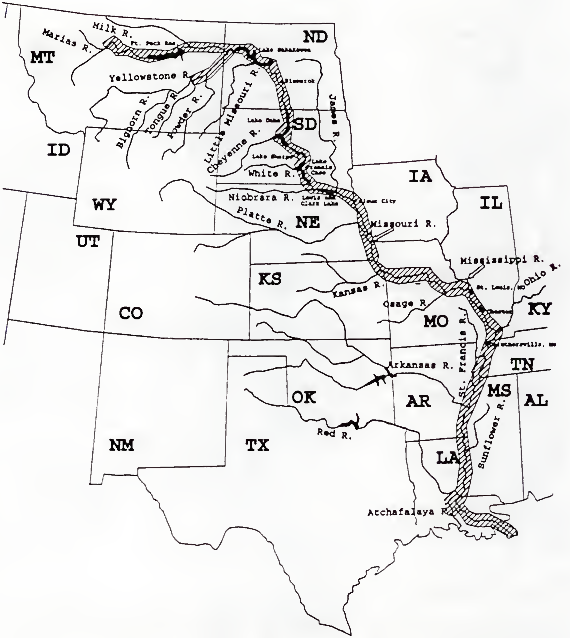

Figure 2. Historic range of the pallid sturgeon. — ▨

occurrence are from the Missouri River between the Marias River and Ft. Peck Reservoir (MT); between Ft. Peck Dam (MT) and Lake Sakakawea near Williston, ND; within the lower 70 miles of the Yellowstone River to near Fallon, MT; at the headwaters of Lake Oahe (ND); at the headwaters of Lake Sharpe (SD); and from the Missouri River near the mouth of the Platte River near Plattsmouth, NE. Areas of most recent and frequent occurrence on the Mississippi River are near Caruthersville, MO; Chester, IL; and in the Mississippi River/Atchafalaya River at the Old River Control (LA).

Habitat Preference:

Habitat preferences are not well known for pallid sturgeon. The most often quoted descriptions of general habitat use by pallid sturgeon are from Gilbraith et al. (1988), "they require large, turbid, free-flowing riverine habitat with rocky substrate;" and from Forbes and Richardson (1905), "they are well adapted to life on the bottom and inhabit areas of swifter water than does the related, but smaller shovelnose sturgeon."

Schmulbach et al. (1975) and Gilbraith et al. (1988), report sturgeon appear to favor areas with strong currents in or near the main channel.

Pallid sturgeon collected from the Missouri River above Garrison Reservoir in North Dakota during spring and fall seasons of 1988 to 1991 were found in deep pools at the downstream end of chutes and sandbars, and in the slower currents of near-shore areas (Sandvol, U.S. Fish and Wildlife Service, pers. comm.).

Current Velocity: Preliminary findings from a study on the Missouri River between Oahe and Big Bend Dams in South Dakota indicate pallid sturgeon most frequently occupy river bottoms where velocity ranges from 10-30 centimeters per second (cps) (Erickson, SD State University, pers. comm.). Studies on micro-habitat selection of pallid sturgeon in Montana found that pallid sturgeon are most frequently associated with water velocity ranging from 40-90 cps (Clancey, MT Dept. of Fish, Wildlife, and Parks, pers. comm.). These velocities are commonly found throughout the species' range.

Turbidity: Pallid sturgeon historically occupied turbid river systems. Turbidity levels where pallid sturgeon have been found in South Dakota range from 31.3 Nephelometric turbidity units (NTU) to 137.6 NTU (Erickson, pers. comm.). Secchi disc depths ranged from an average of 3.0 meters on the Missouri River immediately below Oahe Dam to 0.67 meters in a relatively unaltered reach downstream (Erickson, pers. comm.).

Water Depth: The range of water depths where pallid sturgeon were frequently found in South Dakota are 2-6 meters (Erickson, pers. comm.). In Montana, pallid sturgeon selected depths which ranged from 1.2-3.7 meters in the summer, but selected deeper waters during winter (Clancey, pers. comm.). During late summer in North Dakota, pallid sturgeon were captured at depths which ranged from 2.1-7.6 meters (Sandvol, pers. comm.). One pallid sturgeon collected on the Yellowstone River in July 1991 was caught at a depth of 1-2 meters (Watson and Stewart 1991).

Substrate: Pallid sturgeon are most frequently caught over a sand bottom, which is the most common substrate type within its range. The one pallid sturgeon collected on the Yellowstone River in July 1991 by Watson and Stewart (1991) was reported to be over a bottom of mainly gravel and rock.

Temperature: Pallid sturgeon inhabit areas where the water temperatures range from 0°C to 30°C or greater, which is the normal range of water temperature on the Missouri and Mississippi Rivers. There is no information to indicate temperature preference or the effects of temperature on the species. Curtis (1990) found no relation between surface water temperatures and depth used by shovelnose sturgeon on the Mississippi River and found no indication that shovelnose sturgeon were moving into deeper, cooler water (if available) as water temperature increased.

Life History:

Reproduction: Little to no information exists on pallid sturgeon reproduction, including spawning locations, substrate preference, water temperature, or time of year. Larval pallid sturgeon have never been recorded in larval fish collections.

Only inferences can be made from what is known or suspected about shovelnose and other sturgeon spawning activities.

Shovelnose sturgeon spawning is suspected to occur over rock, rubble, or gravel bottoms in the main rivers and major tributaries or on wing dams in larger rivers (Christensen 1975; Elser et al. 1977; Moos 1978; Helms 1974). Shovelnose sturgeon spawning occurs in the unchannelized Missouri River near Vermillion, South Dakota, in late May and continues through June with water temperatures near 18°C to 19°C. Spawning was suspected in the relatively swift water in or near the main channel (Moos 1978). Shovelnose sturgeon spawning occurs in the Tongue River, Montana, a Yellowstone River tributary, from early June until mid-July at temperatures of 16.9°C to 21.5°C (Elser et al. 1977). On June 12, 1990, running ripe shovelnose sturgeon males and females were captured from the Tongue River, Montana, at a temperature of 20.5°C (Krentz, U.S. Fish & Wildlife Service, pers. comm.). Initiation of sturgeon spawning migrations have been associated with seasonal flow differences in rivers (Peterman 1977; Zakharyan 1972, both cited in Gilbraith et al. 1988).

Age to reach sexual maturity and intervals between spawning were estimated for nine pallid sturgeon. Sexual maturity for males was estimated to be 7 to 9 years, with 2 to 3 year intervals between spawning years. Females reached sexual maturity in 15 to 20 years, with 3 to 10 year intervals between spawning years (Jenkins, U.S. Fish & Wildlife Service, pers. comm.). Time of sexual maturity and the intervals between spawning years may be influenced by available forage, environmental conditions, and other factors.

There are only a limited number of observations of pallid sturgeon with mature gonads. A large female with mature eggs was captured near the mouth of the Yellowstone River on May 26, 1988, and a male with freely running milt was captured at the same location on June 5, 1991 (Sandvol, U.S. Fish & Wildlife

Service, pers. comm.). Two small males removed from near the mouth of the Platte River in May 1991, were determined to be sexually mature (Graham, Missouri Department of Conservation, pers. comm.).

Food and Feeding Habits: Carlson (1985) determined composition by volume and frequency of occurrence of food categories in the diet of shovelnose sturgeon (n=234), pallid sturgeon (n=9) and presumed hybrids (n=9). Aquatic invertebrates (principally the immature stages of insects) comprised most of the diet of shovelnose sturgeon, with pallid sturgeon and presumed hybrids consuming a greater proportion of fish (mostly cyprinids). Other researchers also reported a higher incidence of fish in the diet of pallid sturgeon than in the diet of shovelnose sturgeon (Cross 1967; Held 1969).

Age and Growth: Like other life history variables, little to nothing is known about age and growth of pallid sturgeon. The length of pallid sturgeon was significantly greater than that of shovelnose sturgeon for each age group in which comparable data was available on the lower Missouri and Mississippi Rivers (Carlson et al. 1985). Pallid sturgeon are long-lived fish, achieving ages of more than 40 years (Jenkins, pers. comm.).

Reasons for Decline:

Habitat Loss: The primary reason for decline of the pallid sturgeon is believed to be the extensive modifications of the riverine habitats in the Missouri River and to a lesser extent the Mississippi River.

On the Missouri River, approximately 51 percent of riverine habitat has been channelized, 28 percent impounded, and the remaining 21 percent affected by upstream impoundments and altered flow regimes. The Missouri River downstream from Sioux City, Iowa, has been channelized and stabilized for its entire length. This has resulted in reduced water surface area, channel length, and habitat diversity. This reach was once characterized by islands, chutes, and backwater areas. The river is now confined within a narrow channel of rather uniform width and swift current (Funk and Robinson 1974). Six massive earthen dams on the Missouri River are believed to have adversely affected pallid sturgeon by blocking movement to spawning and/or feeding areas, destroying spawning and nursery areas, reducing habitat diversity, altering conditions or flows at potential remaining spawning areas, reducing food sources or the ability to obtain food, or altering remaining substrates and conditions necessary for survival. The remaining riverine habitat between the main stem Missouri River dams has been changed due to channel degradation, channel confinement, bank stabilization, flow modification, reduced turbidity, and hypolimnetic releases. These habitat alterations are believed to have caused adverse effects on reproduction, growth, and survival of indigenous species, such as the pallid sturgeon.

The Mississippi River within the pallid sturgeon's range has been modified by wing dams, dikes, and bank reventments which have constricted and deepened the channel. These changes have caused the fish fauna composition to change. In the lower channelized river, pelagic planktivores and sight-feeding carnivores have increased in abundance, while species specialized for life in the turbid,

pre-development river (like the pallid sturgeon) have decreased in abundance (Pflieger and Grace 1987).

Commercial Harvest: Historically, pallid, shovelnose, and lake sturgeon were commercially harvested on the Missouri and Mississippi Rivers (Helms 1974). The larger lake and pallid sturgeon were sought for their eggs to be sold as caviar while shovelnose sturgeon were destroyed as a bycatch. Commercial harvest of all sturgeon has declined substantially since record keeping began in the late 1800s. Early harvest records did not distinguish between pallid and shovelnose sturgeon. Combined harvests as high as 195,450 kg were recorded in the Mississippi River in the early 1890s, but had declined to less than 9,100 kg by 1950 (Carlander 1954). Lower harvests reflected a decline in shovelnose sturgeon abundance since the early 1900s (Pflieger 1975). The reasons for this probably include over-fishing.

The states of North Dakota, South Dakota, and Louisiana have recently closed the seasons on both sport and commercial harvest of all sturgeon. However, sturgeon continue to be taken as a bycatch of commercial fishing operations in other states.

Pollution: Although more information is needed, pollution is a likely threat to the species over much of its range. Various fish-harvest and consumption advisories exist or have existed as a result of manmade pollution from near Kansas City, Missouri, to the mouth of the Mississippi River, which represents about 45 percent of the pallid sturgeon's range. As a bottom feeder, one would expect it to be exposed to various pollutants, if present.

Polychlorinated biphenyls (PCBs), DDE, cadmium, mercury, and selenium have been detected at elevated concentrations in tissues of three pallid sturgeon from the Missouri River of North Dakota and Nebraska (Ruelle and Keenlyne 1991). High concentrations of PCBs and detectable concentrations of chlordane, DDE, DDT, and dieldrin were found in the ovary of a pallid sturgeon collected near Auburn, Nebraska (Welsh 1992).

Further investigations are needed to identify sources of contaminants in the Missouri and Mississippi River system and to assess the role of contaminants in the decline of pallid sturgeon populations.

Hybridization: Carlson et al. (1985) found that hybridization had occurred between the pallid sturgeon and the shovelnose sturgeon in the Missouri and middle Mississippi Rivers where 12 hybrids and 11 pallid sturgeon were identified in the total study catch of 4,332 sturgeon. Hybrids have recently been identified in commercial fishermen catches on the lower Missouri and the middle and lower Mississippi Rivers (Graham, pers. comm.; Reed, Louisiana Dept. of Wildlife and Fisheries, pers. comm.). Bailey and Cross (1954) did not report hybrids, which may indicate that hybridization is a recent phenomenon resulting from environmental changes caused by man-induced reductions in habitat diversity and measurable changes in environmental variables such as turbidity, flow regimes, and substrate types (Carlson et al. 1985). Hybridization threatens the survival of pallid sturgeon through genetic swamping and through competition for a limited habitat.

Essential Habitat and Recovery-Priority Management Areas

As previously described, the pallid sturgeon evolved in a riverine environment of diverse morphology, hydrology, and chemistry, and is believed to have moved freely throughout its historic range in order to meet life requisite needs. Also, any actions conducted within a riverine system affects both upstream and downstream habitats. Therefore, nothing short of the pallid sturgeon's known historic range (Figure 2) still provides essential habitat for survival and recovery of the species. However, because it would be impractical to initially implement recovery tasks throughout the pallid sturgeon's historic range, five recovery-priority management areas are identified (Figure 3) and will receive priority for implementation of recovery tasks. They are: 1. the Missouri River from the mouth of the Marias River to the headwaters of Ft. Peck Reservoir; 2. the Missouri River, from Ft. Peck Dam to the headwaters of Lake Sakakawea, including the Yellowstone River upstream to the mouth of the Tongue River; 3. the Missouri River from the mouth of the Niobrara River to the headwaters of Lewis and Clark Lake; 4. the Missouri River below Gavins Point Dam to its confluence with the Mississippi River, more specifically in the areas within 20 miles upstream and downstream of the major tributary mouths, such as the Platte, Kansas, and Osage Rivers; 5. the Mississippi River from its confluence with the Missouri River to the Gulf of Mexico, more specifically in the areas within 20 miles upstream and downstream of major tributary mouths, such as the St. Francis River, Arkansas River, and Red River/Atchafalaya River; and including the upper Atchafalaya River.

Five or more pallid sturgeon have been recorded from each of the recovery-priority management areas since 1980. While there has been no evidence of pallid sturgeon recruitment within any of these areas, reproduction and recruitment of shovelnose sturgeon is occurring within each of these areas. Although genetic relationships are currently unknown, it is speculated that different genetic stocks of pallid sturgeon occur in various river areas. These areas are 1) the Missouri River from the mouth of the Marias River in Montana to Gavin's Point Dam in South Dakota, 2) The Missouri River form Gavin's Point Dam to the Mississippi River and then the Mississippi River to the mouth of the Arkansas River in Arkansas, and 3) the mIssissippi River from the mouth of the Arkansas River to the Gulf of Mexico and including the Atchafalaya River.

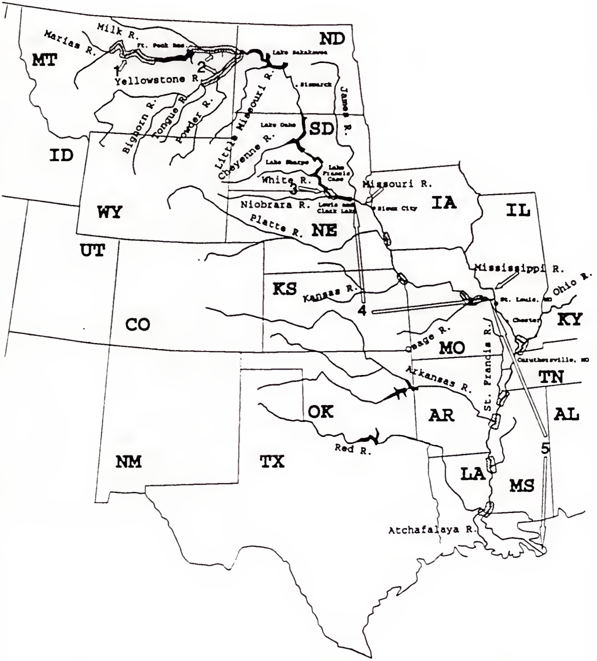

Figure 3. Recovery-priority management areas within the historic range of the pallid sturgeon. —

Part II
RECOVERY

Recovery Objectives

Short-term: The short-term recovery objective for the pallid sturgeon is to prevent extirpation of populations presently occurring in the wild within the next 5 years (1997). The short-term objective will be achieved by: 1) protecting individuals of the species from take, and 2) protecting habitats essential to all life stages. Concurrent with measures taken to protect the species and its habitat, actions will be undertaken to: 3) develop a broodstock and produce progeny representing wild populations for future reintroduction to the wild. The short-term objective will be reached when catch-per-unit-effort (CPUE) remains stable or increases from existing population levels and broodstock refugia are being established at three facilities. These criteria will be further defined as existing population levels are determined at population index sampling stations.

Downlisting Criteria: The long-term recovery objective for the pallid sturgeon is to achieve naturally reproducing, self-sustaining populations within each recovery-priority management areas on the Missouri River from the mouth of the Marias River to the headwaters of Fort Peck Reservoir; from Fort Peck Dam to the headwaters of Lake Sakakawea including the Yellowstone River from its mouth to the confluence with the Tongue River; from Gavins Point Dam to the Mississippi River, and on the Mississippi River from the confluence of the Missouri River to the Gulf of Mexico including the upper reach of the Atchafalaya River, by 2040. A self-sustaining population will have naturally reproduced offspring which reach sexual maturity and reproduce.

An intermediate goal will be to achieve a population structure (young-of-year, juveniles, adults) with at least 10 percent sexually mature females occurring within each recovery-priority management area, by 2025.

The above criteria are preliminary. After better identification of population status and evaluation of the habitat's ability to support self-sustaining populations, more specific, achievable, quantifiable objectives for downlisting and/or delisting will be determined.

Recovery Outline

1. PROTECT PALLID STURGEON POPULATIONS, INDIVIDUALS, AND THEIR HABITAT.

1.1. Reduce or eliminate potential and documented threats from past, present, and proposed developments initially within recovery-priority areas.

  1.1.1. Require Federal agencies to conduct Section 7 consultations on all Federal actions.

  1.1.2. Screen or position water intakes and diversions to reduce entrapment and impingement.

  1.1.3. Provide means for pallid sturgeon to bypass migration restrictions.

  1.1.4. Identify and clean up sources of problem contaminants.

  1.1.5. Control hybridization.

1.2. Restore altered habitats initially within recovery-priority areas.

  1.2.1. Operate Missouri River main stem dams to simulate the natural processes of historic flow patterns and sedimentation.

  1.2.2. Restore the diversity (backwater, sidechannel and braided-channel) of riverine habitats.

1.3. Increase public awareness of the laws and needs for protecting all sturgeon species.

  1.3.1. Develop and distribute information and education materials on the plight of all sturgeon, emphasizing the pallid sturgeon.

  1.3.2. Provide cultured pallid sturgeon to aquariums and comparable facilities where they can be viewed by the public.

1.4. Develop new laws and regulations and encourage enforcement of existing laws and regulations.

  1.4.1. Work with states within the pallid sturgeon's range to temporarily close sport and commercial fishing seasons on all sturgeon species.

  1.4.2. Provide legal protection to habitats important to the conservation and recovery of pallid sturgeon.

  1.4.3. Work with states to control introductions of non-indigenous species within the range of the pallid sturgeon, unless prior studies show no predation/competition concerns.

1.4.4. Include the pallid sturgeon in Appendix I to the Convention on International Trade in Endangered Species of Wildlife Fauna and Flora (CITES).

1.4.5. Support Federal and state agencies in their enforcement of laws and regulations.

2. DEVELOP AND IMPLEMENT A PALLID STURGEON ARTIFICIAL PROPAGATION PROGRAM.

2.1. Propagate and rear pallid sturgeon in hatcheries.

2.1.1. Collect pallid sturgeon broodstock from the wild and maintain refugia at three locations.

2.1.2. Provide financial support to hatcheries for structural modifications needed to propagate and hold pallid sturgeon broodstock.

2.1.3. Obtain sperm from wild pallid sturgeon males for storage in a sperm bank.

2.1.4. Determine guidelines for collecting, handling, and transporting of pallid sturgeon broodstock.

2.1.5. Develop a pallid sturgeon propagation plan, which details the approach to successfully maintaining broodstock and producing progeny for future stocking.

2.2. Reintroduce pallid sturgeon and/or augment existing populations.

2.2.1. Develop a Pallid Sturgeon Stocking Plan, which details the policy and approach to successfully utilize hatchery stock for recovery of wild populations.

2.2.2. Conduct reintroduction/augmentation programs

3. CONDUCT RESEARCH NECESSARY FOR LONG-TERM RECOVERY OF THE PALLID STURGEON

3.1. Obtain information on life history of the pallid sturgeon.

3.1.1. Conduct field investigations to determine age distribution, age and growth characteristics, and growth rates.

3.1.2. Conduct field investigations to describe food habits and feeding behavior.

3.1.3. Obtain an artist's descriptive key of developing larvae and early juveniles of pallid sturgeon, shovelnose sturgeon, and shovelnose X pallid hybrids.

3.2. Obtain information on important habitat requirements of the pallid sturgeon.

3.2.1. Conduct field investigations to describe the micro- and macrohabitat components of spawning, feeding, staging, and rearing areas.

3.2.2. Map areas providing important habitat requirements.

3.3. Obtain information on genetic makeup of hatchery-reared and wild Scaphirhynchus stocks.

3.3.1. Determine the degree of genetic divergence between Scaphirhynchus species within the range of the pallid sturgeon.

3.3.2. Identify genetically meaningful management units (stocks) of the pallid sturgeon.

3.3.3. Determine the extent and management implications of hybridization between Scaphirhynchus species.

3.4. Obtain information on population status and trends.

3.4.1. Establish sampling stations and monitor population status.

3.4.2. Conduct a Population Viability Analysis to determine appropriate recovery numbers.

3.5. Obtain information on chemical contamination of pallid sturgeon and their habitat.

3.5.1. Determine concentrations of organic and inorganic contaminants in pallid sturgeon, shovelnose sturgeon, and sediments.

3.5.2. Determine effects of contaminants identified in sturgeon.

3.6. Obtain information on biological threats.

3.6.1. Determine causes of hybridization.

3.6.2. Determine the extent of parasitism and disease problems, and the degree of predation and competition from introduced fish.

3.7. Obtain information on culture techniques, rearing requirements, and stocking to maximize survival of pallid sturgeon broodstock and progeny.

3.7.1. Develop techniques for collection of gametes.

3.7.2. Conduct rearing trials to maximize survival of broodstock and progeny.

3.7.3. Determine a stocking protocol that promotes good post-stocking survival.

4. DEVELOP A NATIONWIDE PROGRAM TO COORDINATE AND IMPLEMENT CONSERVATION AND RECOVERY OF STURGEON SPECIES.

4.1. Communicate with sturgeon researchers and managers.

4.1.1. Establish a clearinghouse for storage and dissemination of catch data.

4.1.2. Develop and conduct workshops to coordinate pallid sturgeon recovery efforts.

4.1.3. Encourage and support publication of research and other recovery results in technical literature.

4.2. Implement the Pallid Sturgeon Recovery Plan.

4.2.1. Establish and fund a full-time position as pallid sturgeon recovery implementation coordinator.

4.2.2. Develop a long-term strategy for funding sturgeon recovery activities.

Narrative

1. PROTECT PALLID STURGEON POPULATIONS, INDIVIDUALS, AND THEIR HABITAT.

1.1. Reduce or eliminate potential and documented threats from past, present, and proposed developments initially within recovery-priority areas.

1.1.1. Require Federal agencies to conduct Section 7 consultations on all Federal actions.

Section 7 of the Endangered Species Act will play a major role in the protection and recovery of the pallid sturgeon. Federal agencies must immediately consult with the U. S. Fish and Wildlife Service to ensure that actions they authorize, fund, implement, or permit are not likely to jeopardize the continued existence of the pallid sturgeon. Recommendations will be made by the Service to preclude jeopardy, and to conserve and recover the species.

1.1.2. Screen or position water intakes and diversions to reduce entrapment and impingement.

Point-source water intakes serving industry, irrigation, and public water supply must be screened with a 1/4" (6.35 mm) mesh and have an intake velocity of less than 1/2 feet per second (15.24 cm/sec), or be placed at water depths greater than 15 feet (4.575 m) to protect against entrapment or impingement of pallid sturgeon larvae and fingerlings. Large water diversions, such as the U.S. Bureau of Reclamation irrigation diversion at Intake, Montana, must be grated to prevent movement of adult pallid sturgeon into diversion canals. The Corps of Engineers, Bureau of Reclamation, Western Area Power Administration, and other appropriate Federal or State agencies will undertake review of all water intakes and diversions under their jurisdiction to regularly inspect screening to ensure its effectiveness in preventing such loss of young and adult pallid sturgeon.

1.1.3. Provide means for pallid sturgeon to bypass migration restrictions.

Main stem dams on the Missouri River and low-head diversion dams on tributaries prevent pallid sturgeon from migrating to and from traditional spawning areas and other important seasonal habitats. Structural facilities are needed at Ft. Peck Dam, an Army Corps of Engineers' dam, on the Missouri River and at the low-head diversion dam, a Bureau of Reclamation dam, on the Yellowstone River to allow free movement of pallid sturgeon adults within these recovery-priority areas. Efforts will also be undertaken to identify other locations where such structures may be needed.

Population Viability Analysis studies proposed in Task 3.4.2 (Conduct a Population Viability Analysis to determine appropriate recovery numbers) will clarify the necessity of this Task.

1.1.4. Identify and clean up sources of problem contaminants.

After contaminants affecting pallid sturgeon recovery are determined through Tasks 3.5.1 (Determine concentrations of organic and inorganic contaminants in pallid sturgeon, shovelnose sturgeon, and sediments) and 3.5.2 (Determine effects of contaminants identified in sturgeon), the source of problem contaminants must be identified and removed, if possible. Naturally occurring contaminants may be impossible to eliminate. Clean up of contaminants polluting the Missouri and Mississippi Rivers will not only help to recover the pallid sturgeon, but will also help to reduce the human health risk associated with polluted water supplies and fish consumption. These actions will be coordinated with the Environmental Protection Agency and with other Federal and State agencies responsible for control or remediation of contamination.

1.1.5. Control hybridization.

After Task 3.3.3. is conducted to determine the extent of hybridization and Task 3.6.1. is conducted to determine the causes, actions are necessary to control its occurrence. Although recognized as being extremely important, this will be a difficult task to accomplish.

1.2. Restore altered habitats initially within recovery-priority areas.

1.2.1. Operate Missouri River main stem dams to simulate the natural processes of historic flow patterns and sedimentation.

Pallid sturgeon evolved within large rivers exhibiting seasonal patterns of high and low flows, which historically were much different than today's flow patterns regulated by main stem dams on the Missouri River. An agreement must be developed with the Army Corps of Engineers to operate main stem dams to simulate the natural processes of historic flow patterns and sedimentation. The Army Corps of Engineers is in the process of determining historic flow patterns and how main stem dams could be operated to simulate historic processes.

1.2.2. Restore the diversity (backwater, sidechannel and braided-channel) of riverine habitats.

Pallid sturgeon evolved in a diverse river habitat of numerous sandbars, sidechannels, and backwater areas. Main stem dams have inundated 28 percent of the Missouri River, and bank modifications (riprap, wing dikes, jetties, etc.) have channelized 51 percent of the Missouri River and 100 percent of the Mississippi River within the species' range. The benefits of habitat diversity must be restored initially within recovery-priority areas to meet the needs of all life stages of pallid sturgeon. Other flora and fauna endemic to the Missouri and Mississippi Rivers, and showing signs of population decline, will benefit by restoration of the "big-river" ecosystem.

1.3. Increase public awareness of the laws and needs for protecting all sturgeon species.

1.3.1. Develop and distribute information and education materials on the plight of the pallid sturgeon.

In order for pallid sturgeon recovery to be successful, an informational and educational program must be developed to inform the public of: (1) the cause for decline of all sturgeon species, (2) the importance of preserving the pallid sturgeon and the Missouri and Mississippi River ecosystems upon which they depend, and (3) to increase the public's participation in sturgeon recovery efforts. Educational materials such as brochures, newspaper and magazine articles, publications, poster displays, slide and television presentations, etc. specific to the pallid sturgeon and the effects of human alteration of the Missouri/Mississippi River ecosystem must be produced and disseminated to target audiences, which include sport and commercial fishermen.

1.3.2. Provide cultured pallid sturgeon to aquariums and comparable facilities where they can be viewed by the public.

Pallid sturgeon that are reared at hatcheries and not needed for broodstock, reintroduction, research, etc. should be presented to aquariums or similar facilities where they can be viewed by the public.

1.4. Develop new laws and regulations and encourage enforcement of existing laws and regulations.

1.4.1. Work with states within the pallid sturgeon's range to temporarily close sport and commercial fishing seasons on all sturgeon species.

Some loss of pallid sturgeon is occurring incidental to commercial fishing for shovelnose sturgeon. The States of North Dakota, South Dakota, and Louisiana have established regulations to close the fishing seasons on all sturgeon in order to protect against incidental killing of pallid sturgeon. Similar regulations are needed in the range of the pallid sturgeon in Mississippi, Arkansas, Tennessee, Kentucky, Missouri, Illinois, Kansas, Iowa, Nebraska, and Montana. The seasons allowing take of any sturgeon from Missouri River and Mississippi River waters should be closed within the next 3 years and remain closed until sport and commercial fishing activities and techniques are evaluated to determine the extent of their effect upon pallid sturgeon populations.

1.4.2. Provide legal protection to habitats important to the conservation and recovery of pallid sturgeon.

River reaches providing important life requisites, identified through Task 3.2.2. (Map areas providing important habitat requirements) must be protected by State or Federal laws. This could include protection of water rights, through acquisition or formal agreements, to ensure that instream flows within important habitats are legally protected. Land acquisition or conservation easements may also be needed to help protect and restore the diversity of riverine habitats described undert Task 1.2.2.

1.4.3. Work with states to control introductions of non-indigenous species within the range of the pallid sturgeon, unless prior studies show no predation/competition concerns.

Introductions of non-indigenous species must not occur within the range of the pallid sturgeon until effects upon the intra- and interspecific competition, and upon the related biological and ecological interactions within the aquatic community of the pallid sturgeon, are determined. This will require coordination with both state and Federal fishery programs.

1.4.4. Include the pallid sturgeon in Appendix I to the Convention on International Trade in Endangered Species of Wildlife Fauna and Flora (CITES).

The pallid sturgeon is considered a fine eating fish although its greatest value on the commercial market comes from its roe, which is suitable for caviar. The pallid sturgeon must be included in Appendix I to CITES as soon as possible, to further regulate foreign trade and impose additional penalties for illegal activities.

1.4.5. Enforce laws and regulations.

Federal and State agencies must pursue adequate funding levels must be provided to enforce new protection measures and laws identified above. Federal and state wildlife law enforcement programs are understaffed and underbudgeted to meet the increased effort necessary to adequately enforce laws protecting the pallid sturgeon.

2. DEVELOP AND IMPLEMENT A PALLID STURGEON ARTIFICIAL PROPAGATION PROGRAM.

2.1. Propagate and rear pallid sturgeon in hatcheries.

2.1.1. Collect pallid sturgeon broodstock from the wild and maintain refugia at three locations.

Three populations of wild broodstock must be established at separate facilities to guard against catastrophic loss. It is initially recommended that 15-20 females and the same number of males be removed from three management units (river reaches and tributaries) spanning the pallid sturgeon's range. The management units are recommended to be: (A) the Missouri River from the mouth of the Marias River in Montana to Gavin's Point Dam in South Dakota encompassing recovery-priority areas 1, 2, and 3, (B) the Missouri River from Gavin's Point Dam to the Mississippi River and then the Mississippi River to the mouth of the Arkansas River in Arkansas encompassing recovery-priority areas 4 and part of 5, and (C) the Mississippi River from the mouth of the Arkansas River to the Gulf of Mexico including the Atchafalaya River, encompassing the remainder of recovery-priority area 5 (Fig. 4). Pallid sturgeon populations are divided within these three management units to represent possibly genetically distinct populations. Management Unit A broodstock would go to Gavin's Point National Fish Hatchery (NFH) in South Dakota, Management Unit B broodstock to Blind Pony State Hatchery in Missouri, and Management Unit C broodstock to Natchitoches NFH in Louisiana, or to an alternate NFH within the area. Parental stocks and offspring from the three management units will be isolated unless genetic analysis, through implementation of Task 3.3.2., (Identify genetically meaningful management units of the pallid sturgeon and the shovelnose sturgeon), shows range-wide genetic homozygosity.

2.1.2. Provide financial support to hatcheries for structural modifications needed to propagate and hold pallid sturgeon broodstock.

Prior to long-term holding of pallid sturgeon broodstock and implementation of a long-term propagation program, structural improvements are needed at Blind Pony State Hatchery, Gavin's Point NFH and potentially at other hatcheries that participate in the program.

2.1.3. Obtain sperm from wild pallid sturgeon males for storage in a sperm bank.

Removing sexually active males from the wild and moving them to hatcheries may not always be the best alternative depending upon the circumstances of capture location and time of year. Also, females may be ready to spawn when males are not available. Preservation of sperm taken from wild fish will allow return of the males to the wild and fertilization of eggs in the hatchery whenever a ripe female becomes available. The techniques for sperm storage must be developed using shovelnose sturgeon as a surrogate species.

2.1.4. Determine guidelines for collecting, handling, and transporting of pallid sturgeon broodstock.

Standardized protocols, designed to give pallid sturgeon the greatest protection possible, are needed for all activities associated with collecting, handling, and transporting of pallid sturgeon broodstock. Proper handling protocols must be developed and distributed to Service and state agencies potentially handling pallid sturgeon.

Interim protocols have been developed by the Service; however, as new information becomes available through continued efforts, recommendations will be assessed, refined, and incorporated in collecting, handling, and transporting activities as necessary to minimize mortality. The "Hatchery Manual for White Sturgeon" by Conte et al. (1988) is incorporated into the protocols when appropriate.

2.1.5. Develop a Pallid Sturgeon Propagation Plan, which details the approach to successfully maintaining broodstock and producing progeny for future stocking.

An interim Pallid Sturgeon Propagation Plan must be developed to be followed by each propagation facility in order to successfully coordinate accomplishment of propagation objectives for recovery. This Plan would be followed by each facility. It describes Service policy on broodstock development; fish production and production-related research priorities; broodstock and progeny; genetic makeup; broodstock capture locations; and protocol for spawning, holding, and rearing. Refinements to the Plan will be made as information is obtained by implementing tasks within Strategy 3.7. (Obtain information on culture techniques, rearing requirements, and stocking to maximize survival of pallid sturgeon broodstock and progeny) and Strategy 3.3. (Obtain information on genetic makeup of hatchery reared and wild Scaphirhynchus stocks).

2.2. Reintroduce pallid sturgeon and/or augment existing populations.

2.2.1. Develop a Pallid Sturgeon Stocking Plan, which details the policy and approach to successfully utilize hatchery stock for recovery of wild populations.

A Pallid Sturgeon Stocking Plan must be developed before pallid sturgeon progeny are stocked into the wild. This Plan would describe Service policy on stocking objectives, justifications, and conditions under which stocking would occur. It would also include stocking rates and sites to maintain or restore genetic makeup of wild stocks, and will include recommendations on a release size, time, and rate that promotes good post-stocking survival. Information learned from stocking programs for other sturgeon and Colorado River rare fish work, will be used in development of this Plan. Refinements to the Plan will be made as information is obtained through implementation of Tasks under Strategy 3.2. (Obtain information on important habitat requirements of the pallid sturgeon), Strategy 3.3. (Obtain information on genetic makeup of hatchery-reared and wild Scaphirhynchus stocks), Strategy 3.4. (Obtain information on population status and trends) and Strategy 3.7 (Obtain information on culture techniques, rearing requirements, and stocking to maximize survival of pallid sturgeon broodstock and progeny. This Plan will be developed in coordination with states.

2.2.2 Conduct reintroduction/augmentation programs

Stocking of pallid sturgeon for reintroduction or for augmentation of existing populations will be done in accordance with the Pallid Sturgeon Stocking Plan described above. Monitoring of the restocked fish will be needed to determine the success of the reintroduction or augmentation effort.

3. CONDUCT RESEARCH NECESSARY FOR LONG-TERM RECOVERY OF THE PALLID STURGEON

3.1. Obtain information on life history of the pallid sturgeon.

3.1.1. Conduct field investigations to determine age distribution, age and growth characteristics, and growth rates.

Investigations are needed rangewide on species longevity, age and size at sexual maturity, growth rates, and age structure within wild populations. Reliable, non-lethal aging techniques need to be developed. Age and growth information must be recorded from captive, reintroduced, and wild fish to ensure accurate estimates of age. Parties presently holding pallid sturgeon will assist in obtaining this information.

3.1.2. Conduct field investigations to describe food habits and feeding behavior.

Little is known about the food habits or feeding behavior of pallid sturgeon. Further investigations are needed so management recommendations can be made. It is believed that reductions in Missouri River turbidity may have affected food availability by changing prey species composition and by making it more difficult for pallid sturgeon to capture prey in the clearer water environment. Increased velocity in the channelized river reaches might also make it harder to forage.

3.1.3. Obtain an artist's descriptive key of developing larvae and early juveniles of pallid sturgeon, shovelnose sturgeon, and shovelnose X pallid hybrids.

Much of the pallid sturgeon's range overlaps the range of other sturgeon. Research to document successful reproduction and determine abundance, distribution, and ecology of pallid sturgeon early life stages depends on accurate identification of collected larvae, and early juveniles. An artist's descriptive key of a development series for hatchery-reared pallid sturgeon, shovelnose sturgeon and shovelnose/pallid hybrid larvae, which will document their morphological development and reveal diagnostic characters is needed for identification of field-collected specimens. (An artist's descriptive key has been prepared for lake sturgeon.)

3.2. Obtain information on important habitat requirements of the pallid sturgeon.

3.2.1. Conduct field investigations to describe the micro- and macro-habitat components of spawning, feeding, staging, and rearing areas.

Investigation is needed to describe the micro- and macro-habitat characteristics critical for maintenance and recovery of the pallid sturgeon. Telemetry, sonic, or other techniques for tracking pallid sturgeon should be initially conducted within recovery-priority areas so that information on micro- and macro-habitat characteristics for all life stages can be obtained. Micro- and macro-habitat characterizations should be made from collection of data on bottom substrate, water depth, velocity, temperature, turbidity, etc.

3.2.2. Map areas providing important habitat requirements.

Mapping of important habitats will support prioritization of areas for implementation of protection measures in Strategy 1.1 (Reduce or eliminate potential and documented threats from past, present, and proposed developments initially within recovery-priority areas) and implementation of management recommendations under Strategy 1.2. (Restore altered habitats within priority recovery areas).

3.3. Obtain information on genetic makeup of hatchery-reared and wild Scaphirhynchus stocks.

3.3.1. Determine the degree of genetic divergence between Scaphirhynchus species within the range of the pallid sturgeon.

Genetic analysis of Scaphirhynchus species within the range of the pallid sturgeon is necessary to determine genetic divergence for management purposes. Pallid sturgeon and shovelnose sturgeon have been distinguished based upon morphometric and meristic characteristics and character ratios (Bailey and Cross 1954; Williams and Clemmer 1991). Hybridization between the pallid sturgeon and the shovelnose has been proposed based upon these same characteristics. Phelps and Allendorf (1983) were unable to distinguish the species electrophoretically by looking at 37 enzyme systems. Further genetics studies are needed using state-of-the-art analysis techniques such as, mitochondrial DNA (mtDNA), nuclear DNA, and electrophoresis methods. Hatchery-reared pallid sturgeon, shovelnose sturgeon and pallid X shovelnose sturgeon would be used in an analysis. Nonlethal means to obtaining genetic analysis material must be utilized on wild pallid sturgeon. Federal and State agencies involved in collecting, handling, or holding pallid sturgoen will assist in obtaining this information.

3.3.2. Identify genetically meaningful management units (stocks) of the pallid sturgeon.

Research is needed to determine whether or not significant genetic differences exist among pallid sturgeon from throughout the species' range. Determining whether genetic differences exist among populations is essential to ensure successful management and recovery of the species. Genetically meaningful management units would be identified so that reintroduction and/or population augmentation is properly implemented.

Initially, wild populations of the pallid sturgeon are believed to be represented by three management units as described in Task 2.1.1. (Collect pallid sturgeon broodstock from the wild and maintain refugia at three locations).

3.3.3. Determine the extent and management implications of hybridization between Scaphirhynchus species.

Genetic analysis of hybrids is needed to determine if hybridization has resulted in introgression and loss of genetic integrity of pallid sturgeon. The hybrids collected to date exhibit an unbalanced sex ratio with a preponderance of females. Possibly "hybrid breakdown" occurs in back crosses resulting in no loss of genetic integrity for pallid sturgeon. Hatchery- reared hybrids (F_1's, F_2's, and back crosses) must be produced to determine genetic and physical characteristics, sex ratios, and fertility for comparison to wild-caught, presumed hybrids.

3.4. Obtain information on population status and trends.

3.4.1. Establish sampling stations and monitor population status.

Systematic monitoring of pallid sturgeon populations, initially in recovery-priority areas, will be an essential element in measuring response to recovery tasks under Strategy 1.1. (Reduce or eliminate potential and documented threats from past, present, and proposed developments initially within recovery-priority areas), Strategy 1.2. (Restore altered habitats initially within recovery-priority areas), Strategy 1.3. (Increase public awareness of the laws and needs for protecting all sturgeon species), Strategy 1.4 (Develop new laws and regulations and encourage enforcement of existing laws and regulations), and Strategy 2.2. (Reintroduce pallid sturgeon and/or augment existing populations). Population index stations must be established as soon as possible, and monitored annually until the population stabilizes, then every 3 years thereafter to monitor population trends. All stocked pallid sturgeon must be marked for future re-identification.

3.4.2. Conduct a Population Viability Analysis to determine appropriate recovery numbers.

A Population Viability Analysis (PVA) must be conducted to further quantify population levels for recovery goals. A PVA will be useful in determining the level at which the population can be considered self-sustaining and at which recommendations can be made to downlist or delist the pallid sturgeon.

Criteria addressing minimum viable population size and demography must be determined to ensure that the populations can persist through natural reproduction. Monitoring activities will be designed and results evaluated to define when pallid sturgeon populations are self-sustaining. Populations may be defined as genetically meaningful management units as determined by Task 3.3.2. (Identify genetically meaningful management units (stocks) of the pallid sturgeon), if appropriate.

3.5. Obtain information on chemical contamination of pallid sturgeon and their habitat.

3.5.1. Determine concentrations of organic and inorganic contaminants in pallid sturgeon, shovelnose sturgeon, and sediments.

Conduct studies to determine problem environmental contaminants in pallid sturgeon and their habitat rangewide, but with emphasis on priority recovery areas. Shovelnose sturgeon should be used as a surrogate species for contaminant analysis unless non-lethal means of obtaining analysis material are determined. Contaminant analyses must be conducted on all pallid sturgeon mortalities, especially reproductive tissues where contaminants are known to accumulate.

3.5.2. Determine effects of contaminants identified in sturgeon.

Studies are needed to determine the effects of "problem" contaminants upon pallid sturgeon survival, growth, and reproduction. Acting as a surrogate, shovelnose sturgeon progeny and adults should be exposed to the contaminants determined to be at elevated levels by results of Task 3.5.1. (above). The cleanup of contaminant sources (Task 1.1.4.) will be prioritized based upon their threat to pallid sturgeon recovery.

3.6. Obtain information on biological threats.

3.6.1. Determine causes of hybridization.

The factors which facilitate hybridization must be determined so management recommendations under Task 1.1.5. (Control hybridization) can be identified and implemented. This will be a difficult task to accomplish.

3.6.2. Determine the extent of parasitism and disease problems, and the degree of competition and predation by introduced fishes.

Although ongoing investigations have not indicated that disease or parasitism presently pose a threat to the pallid sturgeon, wild populations should be monitored to determine if a problem exists or develops. Any future introductions of non-native sturgeon species, and possibly other introduced fishes, may potentially cause competition with or predation upon the pallid sturgeon, however little evidence is available to identify the degree of occurrence of such competition or predation. Additional studies to obtain this information are needed.

3.7. Obtain information on culture techniques, rearing requirements, and stocking to maximize survival of pallid sturgeon broodstock and progeny.

3.7.1. Develop techniques for collection of gametes.

A procedure for collection of gametes, especially eggs, which will not harm adult pallid sturgeon, must be determined before a full-production propagation program is implemented. Conte et al. (1988) determined procedures for spawning white sturgeon and other Acipenseridae. These techniques and others serve as a guide and are to be tested on shovelnose sturgeon before they are widely used on pallid sturgeon.

3.7.2. Conduct rearing trials to maximize survival of broodstock and progeny.

Pallid sturgeon were first raised in a hatchery in 1992. Adults have only been held for a little longer than 1 year. Rearing trials are necessary to determine the feeds, densities, water temperatures and holding conditions needed to maximize survival of broodstock and progeny. To maximize survival of pallid sturgeon, shovelnose sturgeon are to be used as a surrogate in trials unless surplus pallid sturgeon progeny are available.

3.7.3. Determine a stocking protocol that promotes good post-stocking survival.

The optimum size to enhance survival at time of stocking must be determined. The number of pallid sturgeon to be stocked by area, the duration of stocking, and potential predation-prey relationships must also be determined to provide a reasonable expectation of success. The success of reintroduced and augmented populations will be monitored through implementation of Task 3.4.1., (Establish sampling stations to monitor population status).

4. DEVELOP A NATIONWIDE PROGRAM TO COORDINATE AND IMPLEMENT CONSERVATION AND RECOVERY OF STURGEON SPECIES.

4.1. Communicate with sturgeon researchers and managers.

4.1.1. Establish a clearinghouse for storage and dissemination of catch data.

A central clearinghouse for collection of pallid sturgeon catch records and dissemination of recovery-related information, must be established to maintain records on recovery activities and to improve information exchange. The Service's, Fish and Wildlife Enhancement Office in Bismarck, North Dakota, temporarily serves this function. The recovery coordinator established by Task 5.1.1. (Establish and fund a pallid sturgeon recovery coordinator position) would ultimately be responsible for meeting this need. The Mississippi Interstate Conservation Resource Association (MICRA) can assist with information dissemination.

4.1.2. Develop and conduct workshops to coordinate sturgeon recovery efforts.

Workshops or symposiums should be conducted at least every 3 years to coordinate sturgeon recovery activities. Federal and State agencies should encourage communication among professional and managerial staffs to accelerate recovery efforts. Such communication should include coordination of responsibilities for implementation of the pallid sturgeon recovery program and conducting workshops for the exchange of information on recovery progress to keep staffs aware of state-of-the-art methods, progress, and new initiatives.

4.1.3. Encourage and support publication of research and other recovery results in technical literature.

All recovery managers and researchers are strongly encouraged to publish existing 'gray' literature and research findings in technical publications intended for broad distribution. Financial support will be necessary to pay for publishing costs. Unpublished reports, lists of pertinent literature, and summaries of pallid sturgeon population data have been compiled over the years and should be published.

4.2. Implement the Pallid Sturgeon Recovery Plan.

4.2.1. Establish and fund a full-time position as pallid sturgeon recovery implementation coordinator.

Achievement of pallid sturgeon recovery goals through cooperation of all 13 states, three Service Regions, numerous Federal agencies and planning committees will require the leadership and full-time commitment of a Service fishery biologist assigned solely to that responsibility. The recovery coordinator would establish and lead a multi-disciplinary recovery implementation committee.

4.2.2. Develop a long-term strategy for funding sturgeon recovery activities.

Funding in the amount of approximately $11.3 million over the next 5 years is determined necessary for meeting the short-term recovery objective of preventing species extirpation from the wild. Cost for full recovery is not fully determinable, but estimated to be at least $29.7 million. Existing budgets of participating and responsible parties are not capable of fully funding recovery tasks. Strategies for funding, such as through Congressional appropriation, water-use fees, Federal mitigation programs, or establishing trust accounts, must be determined.

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Part III

IMPLEMENTATION SCHEDULE

The Implementation Schedule (Part III) indicates task priorities, task numbers, task descriptions, duration of tasks, potential or participating parties, and lastly, estimated costs. These tasks, when accomplished, will bring about the recovery objectives for the pallid sturgeon as discussed in Part II of this Plan.

Parties with authority, responsibility, or expressed interest to implement a specific recovery task are identified in the Implementation Schedule. When more than one party has been identified, the proposed lead party is in bold print. The listing of a party in the Implementation Schedule does not imply a requirement or that prior approval has been given by that party to participate or expend any funds. However, parties willing to participate will benefit by being able to show in their own budget submittals that their funding request is for a recovery task which has been identified in an approved recovery plan and is therefore part of the overall coordinated recovery effort to recover the pallid sturgeon. Also, Section 7(a)(1) of the Endangered Species Act directs all Federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of threatened and endangered species.

Following are definitions to column headings and keys to abbreviations and acronyms used in the Implementation Schedule:

Priority #: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

> Priority 1 - All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
>
> Priority 2 - All actions that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
>
> Priority 3 - All other actions necessary to provide for full recovery (or reclassification) of the species.

Task # & Task: Recovery tasks as numbered in the recovery outline. Refer to the Narrative for task descriptions.

Task Duration: Years to complete the corresponding task. Study designs can incorporate more than one task, which when combined can reduce the time needed for task completion.

> Underway - Task already being implemented.

Continuing - Task implementation necessary until recovery.

Participating or Responsible Party: Federal or State government agencies or universities (party) with responsibility and/or capability to fund or carry out the corresponding recovery task.

FWS Reg. - Fish and Wildlife Service Regions (Only states in the pallid sturgeon's range are listed);
- 3 - Minneapolis (IA, IL, MO)
- 4 - Atlanta (KY, TN, AR, LA, MS)
- 6 - Denver (MT, ND, SD, NE, KS)
- 8 - Research (Nationwide)

FWS Prog. - Division or program of the Fish and Wildlife Service
- FFA - Fisheries and Federal Aid
- FWE - Fish and Wildlife Enhancement
- LE - Law Enforcement
- RES - Research/Fish & Wildlife Service Coop. Research Units

Other Agencies
- BR - Bureau of Reclamation
- COE - Corps of Engineers
- EPA - Environmental Protection Agency
- FDA - Food & Drug Administration
- WAPA - Western Area Power Administration
- States - State Fisheries or Research Divisions (Some states are listed separately)

Cost Estimates: Estimated fiscal year cost, in thousands of dollars, to complete the corresponding task. The costs associated with a task or party represent the estimated dollar amount to complete the task and is not necessarily the fiscal responsibility of the associated party.

Study designs can incorporate more than one task, which when combined can reduce the cost from when tasks are conducted separately. Cost for implementing "continuing" recovery tasks are in excess of what is displayed through FY-95. Total costs for recovery do not reflect financial needs associated with implementing many of the tasks identified under work area number 1 (protect pallid sturgeon populations, individuals, and their habitat), which costs are undeterminable at this time.

Comments: Additional information if appropriate.

PALLID STURGEON
RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK	TASK DURATION (YRS)	PARTICIPATING OR RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS Reg.	FWS Prog.	OTHER Agencies	FY93	FY94	FY95	
1	1.1.1	Require Federal agencies to conduct Section 7 consultations on all Federal actions.	Continuing	6,3,4	FWE		*	*	*	*Costs per agency are dependent upon the number of actions requiring consultation and are undeterminable.
						COE	*	*	*	
						BR	*	*	*	
						WAPA	*	*	*	
						FDA	*	*	*	
						EPA	*	*	*	
1	1.1.2	Screen or position water intakes and diversions to reduce entrapment and impingement.	Continuing	6,3,4	FWE		*	*	*	*Costs are dependent upon the numbers of intakes requiring screening, which is unknown, thus costs are undeterminable.
						COE	*	*	*	
1	1.1.3	Provide means for pallid sturgeon to bypass migration restrictions.	20	6	FWE		*	*	*	*Costs are undeterminable.
						COE	*	*	*	
						BR	*	*	*	
1	1.1.4	Identify and clean up sources of problem contaminants.	20	6,3,4		EPA	*	*	*	*Clean up costs are undeterminable until Tasks 3.5.1 and 3.5.2 are completed.
						WAPA	*	*	*	
					FWE		*	*	*	
1	1.1.5	Control hybridization.	20	6,3,4	FWE		*	*	*	*Costs are undeterminable until Tasks 3.3.3 and 3.6.1 are completed.
						COE	*	*	*	
1	1.2.1	Operate Missouri River main stem dams to simulate the natural processes of historic flow patterns and sedimentation.	Continuing	6		COE	*	*	*	*No direct costs associated with modifying operations; however, indirect cost from lost power production, navigation, recreation, and flooding may be incurred.
						WAPA	*	*	*	
					FWE		*	*	*	
1	1.2.2	Restore the diversity (backwater, sidechannel, and braided-channel) of riverine habitats.	20	6,3,4		COE	*	*	*	*Costs dependent upon numbers of sites restored.
					FWE		*	*	*	
					FFA		*	*	*	
1	1.3.1	Develop and distribute information and education materials on the plight of all sturgeon, emphasizing the pallid sturgeon.	Continuing	6,3,4	FWE		10	10	10	
					FFA		10	10	10	
						COE	10	10	10	
						BR	10	10	10	
						WAPA	10	10	10	
1	1.3.2	Provide cultured pallid sturgeon to aquariums and comparable facilities where they can be viewed by the public.	Continuing	6,3,4	FWE		*	*	*	*Cost is insignificant.
					FFA		*	*	*	

PALLID STURGEON
RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK	TASK DURATION (YRS)	PARTICIPATING OR RESPONSIBLE PARTY FWS		OTHER	COST ESTIMATES ($000)			COMMENTS
				Reg.	Prog.	Agencies	FY93	FY94	FY95	
1	1.4.1	Work with states within the pallid sturgeon's range to temporarily close sport and commercial fishing seasons on all sturgeon species.	3	6,3,4	FWE FFA	States	5 5 *65	5 5 65	5 5 65	$5K/State allocated.
1	1.4.2	Provide legal protection to habitats important to the conservation and recovery of pallid sturgeon.	5	6,3,4	FWE	States	5 *65	5 65	5 65	$5K/State allocated.
1	1.4.3	Work with states to control introductions of non-indigenous species within the range of the pallid sturgeon, unless prior studies show no predation/competition concerns.	3	6,3,4	FWE	States	5 5	5 5	5 5	
1	1.4.4	Include the pallid sturgeon in Appendix 1 to tha Convention on International Trade in Endangered Species of Wildlife Fauna and Flora (CITES).	1 Underway	6	FWE FFA	States	* * 3			*Conducted with existing program funding prior to FY-93.
1	1.4.5	Support Federal and State agencies in their enforcement of laws and regulations.	Continuing	6,3,4	LE	States	9 39	9 39	9 39	$3,000 per FWS Region and $3,000 per state allocated.
1	2.1.1	Collect pallid sturgeon broodstock from the wild and maintain refugia at three locations.	Underway Continuing	6,3,4	FFA	MDC	20 10	20 10	20 10	Collectons from wild conducted with existing program funds. Dollar amounts represent cost for maintaining refugia at 1 state and 2 Federal facilities.
1	2.1.2	Provide financial support to hatcheries for structural modifications needed to propagate and hold pallid sturgeon broodstock.	2	6,3,4	FFA	MDC	1204	510		Involves redesign, expansion, and upgrades of holding and rearing facilities.
1	2.1.3	Obtain sperm from wild pallid sturgeon males for storage in a sperm bank.	2 Underway	6,4	FFA	MDC	* 5	*		*Conducted with existing program funding.

PALLID STURGEON
RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK	TASK DURA-TION (YRS)	PARTICIPATING OR RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS Reg.	FWS Prog.	OTHER Agencies	FY93	FY94	FY95	
1	2.1.4	Determine guidelines for collecting, handling,and transporting of pallid sturgeon broodstock.	1	6,8	FFA		5			Cost incurred in development of techniques.
					RES		5			
1	2.1.5	Develop a pallid sturgeon propagation plan, which details the approach to successfully maintaining broodstock and producing progeny for future stocking.	Under-way	6	FWE		*	*	*	*Conducted with existing program funding.
					LE		*	*	*	
1	2.2.1	Develop a Pallid Sturgeon Stocking Plan, which details the policy and approach to successfully utilize hatchery stock for recovery of wild populations.	1 Under-way	6	FFA		*			*Conducted with existing program funding prior to FY-93 and will include coordination with states.
						States	*			
1	3.1.3	Obtain an artist's descriptive key of developing larvae and early juveniles of pallid sturgeon, shovelnose sturgeon, and shovelnose X pallid hybrids.	2	6	FFA		10	10		
						Univ.	10	10		
1	3.2.1	Conduct field investigations to describe the micro- and macro-habitat components of spawning, feeding, staging, and rearing areas.	5 Under-way	6,3,4,8	FFA		60	60	60	Funding level and duration are estimated at being sufficient to support two investigations in separate locations.
					RES		60	60	60	
						COE	50	50	50	
						WAPA	50	50	50	
						BR	50	50	50	
1	3.2.2	Map areas providing important habitat requirements.	5	6,3,4	FWE		30	30	30	
						COE	50	50	50	
1	3.3.1	Determine the degree of genetic divergence between *Scaphirhynchus* species within the range of the pallid sturgeon.	2 Under-way	6,3,4	FWE		*50			*Equal costs have already been spent in FY-92. Tasks 3.3.1, 3.3.2, and 3.3.3 are being conducted under one funding agreement. States can assist with collections.
					FFA		5			
						COE	*50			
						States	39			

PALLID STURGEON
RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK	TASK DURA-TION (YRS)	PARTICIPATING OR RESPONSIBLE PARTY FWS Reg.	FWS Prog.	OTHER Agencies	COST ESTIMATES ($000) FY93	FY94	FY95	COMMENTS
1	4.2.1	Establish and fund a full-time position as a pallid sturgeon recovery implementation coordinator.	Continuing	6,3,4	FWE		70	70	70	
2	2.2.2	Conduct reintroduction/augmentation programs.	15	6,3,4	FFA	States	* *	* *	* *	*Costs dependent upon numbers of stockings and are undeterminable at this time.
2	3.1.1	Conduct field investigations to determine age distribution, age and growth characteristics, and growth rates.	5	6,3,4,8	FFA	States	20 *65	20 65	20 65	*$5K per state.
2	3.1.2	Conduct field investigations to describe food habits and feeding behavior.	3	6,3,4	FFA	States	20 *65	20 65	20 65	*$5K/State
2	3.3.3	Determine the extent and management implications of hybridization between *Scaphirhynchus* species.	2 Underway	6,3,4	FWE FFA	COE	* *			*Cost included in amount for Task 3.3.1.
2	3.4.2	Conduct a Population Viability Analysis to determine appropriate recovery numbers.	5	8,6,4,3	RES FFA		150 15	150 15	150 15	
2	3.6.1	Determine causes of hybridization.	10	6,3,4	FFA	COE	5 100	5 100	5 100	Will be difficult to accomplish.
2	4.1.2	Develop and conduct workshops to coordinate sturgeon recovery efforts.	Continuing	6,3,4,8	FWE			20		Workshops proposed for FY-94 and every 3 years thereafter.
3	3.6.2	Determine the extent of parasitism and disease problems.	2	6,3,4,8	RES FFA		40 10	40 10		
3	4.1.3	Encourage and support publication of research and other recovery results in technical literature.	Underway Continuing	8,6,3,4	RES FFA FWE		5 2 2	5 2 2	5 2 2	

PALLID STURGEON
RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK	TASK DURA-TION (YRS)	PARTICIPATING OR RESPONSIBLE PARTY FWS Reg.	FWS Prog.	OTHER Agencies	COST ESTIMATES ($000) FY93	FY94	FY95	COMMENTS
1	3.3.2	Identify genetically meaningful management units (stocks) of the pallid sturgeon.	2 Under-way	6,3, 4	FWE FFA	COE States	* *			*Cost included In amount for Task 3.3.1.
1	3.4.1	Establish sampling stations and monitor population status.	Contin-uing	6,3, 4	FFA FWE	BR COE WAPA States	*90 **5 5 5 5 65	90 5 5 5 5 65	90 5 5 5 5 65	*$30K for FFA In each Service Region. **$5K for each state and other agencies. Sampling stations and protocol will be established in FY-92.
1	3.5.1	Determine concentrations of organic and inorganic contaminants in pallid sturgeon, shovelnose sturgeon, and sediments.	5 Under-way	6,3, 4,8	FWE FFA	EPA	150 15 75	150 15 75	150 15 75	
1	3.5.2	Determine effects of contaminants identified in sturgeon.	2	8,6	RES FWE	EPA WAPA	100 5 100 100	100 5 100 100		
1	3.7.1	Develop techniques for collection of gametes.	2 Under-way	6,4	FFA RES	MDC	* * *			*Conducted with existing program funding prior to FY-93.
1	3.7.2	Conduct rearing trials to maximize survival of broodstock and progeny.	2 Under-way	6	FFA	MDC	*			*Conducted with existing program funding prior to FY-93 at a cost of approximately $10K/facility.
1	3.7.3	Determine a stocking protocol that promotes good post stocking survival.	10	6,3, 4	FFA		80	80	80	Important component of Task 2.2.1 although can be researched seperately.
1	4.1.1	Establish a clearinghouse for storage and dissemination of catch data.	Under-way Contin-uing	6	FWE		*	*	*	*Conducted with existing program funds.

PALLID STURGEON
RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK	TASK DURATION (YRS)	PARTICIPATING OR RESPONSIBLE PARTY FWS Reg.	FWS Prog.	OTHER Agencies	COST ESTIMATES ($000) FY93	FY94	FY95	COMMENTS
3	4.2.2	Develop a long-term strategy for funding sturgeon recovery activities.	Underway Continuing	6,3, 4,8	FWE FFA		* *	* *	* *	*Conducted with existing program funds.